hollow circular cylinder of the same thickness and the same sectional area. Experiments upon the torsional strength of hollow prisms of various forms, having the same sectional area and thickness of shell, can alone determine the latter point; while, at the same time, such experiments would serve the further purpose of showing how the condition above referred to—that the shell shall be stiffened internally so as to effectually resist change of form—can best be complied with.

The distribution of the torsional stresses over the transverse section of a ship's hull is obviously different from the distribution of the stresses due to longitudinal bending. The parts subjected to greatest stress by twisting are those which are near to the centre of gravity of the transverse section; and they are the side plating near the neutral axis of longitudinal bending in the upright position and the middle portions of the plating of the decks. Those parts of the hull which are usually made the strongest, viz., the strakes of side and bottom plating that are farthest from the neutral axis, and the upper deck stringer plate, are those which are least affected by twisting. It is probably owing, in great measure, to the straining action caused by twisting, that experience has proved it to be necessary to make the outside plating of a ship of nearly uniform thickness over the whole section; and it cannot be because of the reason sometimes given, that the plating in the vicinity of the neutral axis when a ship is upright is often brought by rolling into positions in which it is greatly strained by longitudinal bending.

The importance of many of the structural arrangements of ships that are described in the present paper, which practical experience has shown to be necessary, may be understood from these considerations; and it will also be seen that no rules for regulating the strength of ships are likely to be satisfactory if based, as is often done, upon the hypothesis that the straining actions caused by longitudinal bending are so much more important than all others that it is sufficient to regard them alone.

III. "Proteid Substances in Latex." By J. R. Green, B.Sc., B.A., Demonstrator of Physiology in the University of Cambridge. Communicated by W. T. Thiselton Dyer, C.M.G., F.R.S., Director of Royal Gardens, Kew. Received January 4, 1886.

In the study of the metabolism of plants, the nature of the products resulting therefrom, and the different forms assumed by these bodies during the changes involved, attention has been chiefly

directed to the seed. No doubt special facilities for investigation are afforded thereby, for the different bodies can be detected there by the aid of the microscope, and their behaviour under the action of different reagents watched. Hence valuable results have been arrived at, and our knowledge of vegetable metabolism has made considerable advance. By the investigations of Hoppe-Seyler,* Weyl,† and Zoller,‡ the similarity of vegetable proteids to those occurring in animals was pointed out, members of the globulin family at least being shown to exist. Later Vines, by an exhaustive examination, both macroscopic and microscopic, of a very large number of seeds, has added greatly to our knowledge of these bodies, proving that besides globulins, a form of albumose, albuminates, and coagulated proteids are to be isolated, and showing the actual conditions and proportions in which these are present in the seeds.§

It is evident, however, that our knowledge of the seed, even if made complete, will not give us all the information we require concerning the nitrogenous metabolism of the plant. The condition of the proteid matter at a time antecedent to its appearance as reserve material must be considered as equal in importance and in interest. The round of changes going on normally in the leaves and the soft tissues of the stem has hitherto remained unknown, nor had we any knowledge of the condition and characters of the proteid bodies circulating in the plant, and met with in the latex and in the soft green parts until recently, when Martin|| published an account of his investigations into the nature and action of the ferment present in the Papaw plant (*Carica papaya*) and has therein described certain proteids which he has found to be present in the dried milk of the fruit of the plant. These he says are four in number, two belonging to the group of the albumoses, a globulin and an albumin. To the albumoses, which are the most plentiful in amount, he gives the names of α and β phytalbumose.

During the summer of 1884 I was enabled, through the kindness of Mr. Thiselton Dyer, Assistant Director of the Royal Gardens, Kew, to make some investigations into the composition of the latex of several caoutchouc-yielding plants belonging to the natural orders *Apocyneæ* and *Sapotaceæ*.¶ In most cases the latex was a very complex fluid, containing, besides proteids and carbohydrates, considerable

* "Med.-Chem. Unters.," 1867.

† "Zeitschr. f. Physiol.-Chem.," i, 1877; "Ber. d. deut. Chem. Ges.," xiii, 4, 1880.

‡ "Ber. d. deut. Chem. Ges.," xiii, 10, 1880.

§ "Journal of Physiology," vol. iii, No. 2.

|| *Ibid.*, vol. v, No. 4, and vol. vi, No. 6, p. 336.

¶ [These samples, thirty-four in number, were collected for Dr. Vines with very great pains and trouble by Mr. D. F. A. Hervey, Resident Councillor, Malacca.—W. T. T. D.]

quantities of caoutchouc, resinous matters, &c., the latter being very variable in amount, and absent from some samples. The material was collected in the Malay Peninsula from the plants, and a little alcohol having been added as a preservative, was sent to England in sealed bottles. On its arrival at the laboratory, some of the bottles had their contents hardly at all changed except that the large amount of caoutchouc contained in the fluid had undergone the process technically known as coagulation, and was floating in a milky liquid. Others had become quite spoiled in transit, the latex having deposited a quantity of amorphous matter, which gave a xanthoproteic reaction, and seemed to be coagulated proteid. In the *débris* besides this, there appeared under the microscope, a number of small droplets of caoutchouc, a few sphæro-crystals, some spicular crystals, and some flat plates of rhomboidal form.

Examination of these last as to proteids not being practicable, attention was given to the uninjured samples, which differed in no way from each other. The particular experiments, whose results are detailed below, were made upon the latex of a plant, the Malay name of which was given as "Gegrip puteh."*

The mass of caoutchouc floating in the fluid was allowed to drain dry, and was then with difficulty cut up into small pieces and macerated some in water and some in salt solutions. Soaking for several days failed to extract anything of a proteid nature from it. Attention, therefore, was directed to the liquid remaining after its separation. This, as said above, was milky in appearance, of a faintly yellow colour, aromatic smell, and neutral reaction. Under the microscope it was at once apparent that the milky appearance was due to minute droplets of caoutchouc which had not separated out with the bulk. There was nothing granular or amorphous visible, showing that the proteids had not been precipitated by the alcohol used. To free the latex from the caoutchouc, filtration under vacuum pressure through a porous pot was necessary, when the droplets formed a film round the earthenware, and as the liquid was gradually removed they fused together, giving rise to a thin sheet of india-rubber. The fluid passed through the pot clear and in a condition fit for examination.

In this liquid so prepared a very curious proteid body was found to exist, differing in important particulars from any hitherto described as occurring in plants.† Its presence was readily shown by the

* [Yielded by an Apocynaceous plant, *Parameria glandulifera*. The selection of this particular sample, which happened to stand first in a series of thirty-four, was a little unfortunate, as it is not a very characteristic caoutchouc-yielding species.—W. T. T. D.]

† In a communication made to the Cambridge Philosophical Society I have already given a brief account of its properties and reactions ("Proc. Camb. Phil. Soc.," vol. v, Part III, p. 183, October term, 1884).

xanthoproteic reaction, the orange colour on the addition of the ammonia being very marked. On warming the liquid gradually to boiling point there was no coagulation or opalescence, and on adding nitric acid there was no precipitate. Hence the body does not belong to the groups of albumins or globulins. On dropping the boiled liquid into large excess of alcohol, a precipitate was slowly formed, which after standing some hours settled to the bottom of the vessel. These reactions suggested a member of the class of peptones, and as these proteids, though thrown down from their watery solutions by alcohol, are not changed by contact with the spirit, the precipitate was allowed to remain as it settled for about three weeks. At the expiration of that time the alcohol was decanted off, and the precipitate dried. It was then found to be freely soluble in distilled water, and to give, as the original latex did, a well-marked xanthoproteic reaction.

A further resemblance between this body and the group of peptones was revealed by its behaviour when submitted to dialysis. A quantity of the solution of the precipitate that had been standing under alcohol was put into a dialyser and suspended in twice its volume of distilled water. After two days the fluid outside the dialyser was examined. It gave readily the xanthoproteic reaction, and on addition of a large volume of alcohol a marked opalescence appeared, which on standing became a precipitate. Hence this proteid body appeared to have considerable resemblance to the group of peptones, if not to be a member of it.

Further examination, however, brought to light some points that indicated a relation to the albumoses also. Saturation of the solution of the alcohol precipitate by solid $MgSO_4$ gave a copious precipitate, which was redissolved on adding water. The liquid outside the dialyser in the last experiment behaved similarly. The precipitation took place with equal readiness whether the reaction of the solution were neutral or slightly either alkaline or acid. Till recently the precipitation of a proteid by saturation of its solution with a neutral salt was held to be a mark of a globulin, but this reaction cannot now be held to be sufficient of itself to prove this. Halliburton has shown* that it is possible to precipitate serum albumin by such a process, the salt necessary being the double sulphate of magnesium and sodium. Heynsius has stated† that peptone itself may be thrown down from its solution by ammonium sulphate in similar quantity; a statement that is endorsed by Martin.‡ Pollitzer§ denies this, as far as true

* "Journal of Physiology," vol. v, No. 3, p. 182.

† "Pflüger's Archiv," Bd. 34, s. 330.

‡ *Loc. cit.*, p. 343.

§ "Ueber den Nahrwerth einiger Verdanungsproducte des Eiweisses," "Pflüger's Archiv," Bd. xxxvii, H. 5 & 6, 1885.

peptone is concerned, and shows that by the process peptones and albumoses may be separated. A recent paper by Kühne* also discusses this question, and shows that true peptone remains in solution while the ammonium sulphate throws down all the albumoses. He further explains the results that Heynsius arrived at, by showing that the commercial specimens of peptones that the latter used and thought to be pure were largely mixed with albumoses. Though peptone has not yet been precipitated by saturation of its solution with neutral salts, it seems to be almost the only form of proteid that has refused to behave so, and it seems to be rather a question of what salt will throw down a particular proteid, than that such precipitation is a mark of any particular group.

The solution of the alcohol precipitate differed also from that of an animal peptone, in not giving a pink colour on the addition of sodic hydrate and a drop of cupric sulphate (biuret reaction). It agreed with it, however, in not giving a precipitate with potassic ferrocyanide and acetic acid.

Careful investigation of this body disproved the idea that it might really consist of a mixture of an albumose and a peptone for the solution of the precipitate, whether prepared by saturation with neutral salt, or by treatment with excess of alcohol, uniformly answered all the tests applied as described above. The dialysate also behaved on all these points just as the solution before dialysis. There is no doubt, therefore, that the body was a single one and not a mixture.

In examining the proteids found in other plants this body was again met with, and its reactions investigated at some length. It will be convenient therefore to postpone summarising them until later.

A little later in the year Mr. Dyer kindly sent me a bottle of the latex of *Mimusops globosa*, Gærtu (*Sapotaceæ*).† This differed very much from that of the East Indian latex-yielding trees, being a thick, almost pasty, liquid of white appearance and sour smell. It would not filter clear through paper and was therefore submitted to the action of the filter-pump used before. The diluted filtrate, and a watery extract of the dried residue, were taken for examination.

The solution thus obtained proved on investigation to contain two proteid bodies, which could be separated from each other with tolerable ease. On heating the solution gradually, having first neutralised, a little opalescence appeared, but it did not become particulate even at the boiling point. When the liquid was made either

* "Albumen und Peptone," "Verhand. d. Naturhist.-Med. Ver.," Heidelberg, N. F., Bd. iii, H. 4, 1885, s. 286.

† [The well-known source of the Gum Balata of British Guiana, from which the specimen was obtained. The specimens were kindly procured by Mr. G. S. Jenman, Superintendent of the Botanic Garden, British Guiana.—W. T. T. D.]

acid or alkaline, however, it behaved differently. In a nitric acid solution an opalescence was noticeable when the temperature had risen to 85—90° C. This was not removed by the addition of more nitric acid. On keeping the vessel for some time at this temperature, the opalescence became a precipitate, which was soluble at ordinary temperatures in alkalis, slightly so in water, but not in nitric acid. The solutions gave the xanthoproteic reaction. A curious point about this body was the slowness with which the precipitate formed, it appearing not at all like the usual conversion into coagulated proteid on a rise of temperature, but more like a slow precipitation by the reagent at that particular point. This was confirmed by several experiments, one of which, often repeated, was the following. A quantity of the extract was made acid with nitric acid and warmed to 75° C., a point considerably below that at which the precipitate was first observed to form. It was then allowed to cool, and as the temperature was gradually falling, the precipitate slowly separated out. The body seemed then to be slowly precipitated by nitric acid, but not at the ordinary temperature.

In an alkaline solution its behaviour was somewhat different. The opalescence set in at 79° C., and a bulky precipitate settled out slowly at 85° C. This was soluble to a large extent in nitric acid, and was reprecipitated when the liquid was made alkaline. A solution in caustic soda of the precipitate caused by nitric acid at 85° C. behaved similarly. The precipitation here also seemed to be caused by the reagent and not by the temperature, for the alkaline liquid deposited the proteid body on cooling just as the acid one did, and in about the same time as when the temperature was kept constant at 85° C. Both precipitates were unaltered in the separation; each went into solution readily in its appropriate medium, the solutions all giving the xanthoproteic reaction.

This proteid gave no precipitate with acetic acid and potassic ferrocyanide.

After removal of this body by repeated boiling and filtration, the clear fluid gave a good xanthoproteic reaction. On applying some of the tests used in the case of the East Indian latex, the same peptone-like body was found to be present. It dialysed readily, and the solution in water gave a precipitate on saturation with solid $MgSO_4$.

Hence it appears that the latex of *Mimusops globosa* contains two proteids, one a member of the albumose group, precipitated under certain conditions by nitric acid or by potash, but not by boiling, and the other more nearly related to the peptones.

In 1823, Boussingault and Mariano de Rivero* published some observations on the latex of the cowtree of South America (*Brosimum*

* "Mémoire sur le Lait de l'Arbre de la Vache (Palo de Vaca)," "Annales de Chimie et de Physique," t. xxiii, 1823, p. 219.

galactodendion, Don), one of the *Artocarpeæ*. They describe it as containing, among other constituents, a fibrous matter of animal nature, which was obtained by evaporating the latex down to dryness, washing the residue with essential oils to free it from waxy and resinous matters, and then getting rid of the essential oils by pressing dry and boiling with water. This treatment left them a brown mass which contained nitrogen. On heating this on hot iron they say it burned, giving off an odour similar to that coming from meat heated in the same way. This matter was not soluble in alcohol, and when obtained by repeated extraction with hot spirit, was left as a residue composed of white flexible threads. Thinking it possessed all the characteristics of animal fibrin they gave it the same name.

Since the date of their paper no information has been forthcoming as to the real nature of this vegetable fibrin. A quantity of the latex was obtained by Dr. Vines from Dr. Ernst of Caracas, and a bottle of it was, by his kindness, made available for the purposes of this investigation. The fluid had been mixed with a small amount of alcohol with a view to its preservation during its transit to England, and the treatment had been not quite so successful as that of the East Indian latex, some, but not much, of the proteid having been coagulated by the spirit. Still the fluid was of thick creamy consistency, and on digestion with water, and subsequent filtration, yielded a strongly proteid solution.* Extracts were made with water and with solutions of neutral salts, but the resulting liquid behaved in the same manner by whichever method it was prepared.

This extract contained two proteids, one of which was of the nature of an albumin. When the solution made with distilled water was examined, it was found to contain no salts capable of holding a globulin in solution, the only ones present being a mere trace of phosphates. The solution, on being dialysed till free from salts altogether, did not deposit any precipitate. On being boiled there was a well-marked coagulum, and after filtration the now coagulated matter gave a strongly marked xanthoproteic reaction. When the solution was gradually heated in the usual apparatus† the coagulation of the proteid took place at 68° C. The other tests for a proteid were fairly satisfactory, but were applied with more difficulty than with an animal albumin. With Millon's reagent there was a white precipitate, which went brick-red on boiling; with copper sulphate and sodic hydrate the violet colour was obtained, but not unless the soda solution was very strong. There was, however, no precipitate with acetic acid and potassic ferrocyanide.

* The results of my examination of this latex, and a summary of the properties of the bodies found in this and other vegetable fluids described later, were communicated to the Physiological Society at its Cambridge meeting, May 9, 1885.

† Gamgee's "Physiological Chemistry," p. 15.

This body is of great interest, as till lately no true albumin has been described as occurring in plants. Ritthausen's albumins, described by him in 1872,* as found in seeds, have been shown by later observers, notably by Vines, to be rather globulins held in solution by the neutral salts present in the seeds. Even Ritthausen himself admits that the existence of a true albumin in seeds had not been established satisfactorily as lately as 1877.‡ In Martin's paper already referred to, he describes a body which he has found to be present in Papaw juice, which has the properties of an albumin. It is coagulated on boiling, is not precipitated on dialysing an extract of the juice, nor on saturating the solution by solid neutral salt. The body just described as occurring in the latex of *Brosimum* seems to be identical with this. It is noteworthy that both in the case of Martin's albumin and that which has just been described, the albumin appears to be a form of the circulating and not of the reserve proteid. Boussingault's vegetable fibrin was probably this albumin coagulated by the action of the hot alcohol used in its extraction. There was no other body in the latex that would become coagulated proteid.

The other proteid found in this latex remained in solution after boiling and filtering off the coagulated albumin. It was hence not changed by heating; it dialysed easily through a membrane, was precipitated but not coagulated by alcohol, and was precipitated by saturation of its solution by solid $MgSO_4$. It was therefore the same body as described above as a constituent of the East Indian latex. In the *Brosimum* latex there was a larger amount of it present, and its reactions were therefore carefully confirmed. Besides those already mentioned, two more peculiarities were noticed. In dilute solution, a stream of CO_2 passed through it for several hours caused a precipitate. On submitting it in concentrated or dilute solution to the action of artificial gastric juice, it underwent conversion into a true peptone, which gave a biuret reaction as readily as peptone prepared by the same method from fibrin or other animal proteid. There was not, however, during the digestion, any formation of acid albumin.

To protect the result from a danger of error arising from peptone being present in the artificial gastric juice employed, the experiment was performed as follows:—

A certain amount of the proteid was taken from under alcohol, dissolved in water, and the solution decolorised by filtration through animal charcoal. A solution of pepsin in 0·4 per cent. HCl was made and filtered. To a quantity of the proteid solution an equal

* "Die Eiweiss-Körper der Getreidearten, &c.," 1872.

† *Loc. cit.*

‡ "Pflüger's Archiv," xv, 1877, p. 284.

bulk of this extract was added, and a similar quantity of the same was added, in another vessel, to as much water as the quantity of the proteid solution taken. The two were submitted to a temperature of 40° C. for twenty-four hours. The biuret test was then applied to both, care being taken to have equal quantities taken, and the same amount of caustic soda and copper sulphate added to each. Peptone was shown to be present in both, but the colour was the deeper in the case of the proteid solution. Hence, though a trace of peptone was present in the juice employed, the experiment showed formation from the proteid in the latex.

All the material investigated so far had been taken from the plant a considerable time before being examined; also a certain but varying amount of alcohol had been mixed with it. There was consequently a double possibility of decomposition of some sort having taken place. In one case at least there was no doubt that a certain portion of the proteid had been coagulated. It seemed desirable therefore to investigate certain plants that could be obtained in fair quantity in the fresh condition, and as laticiferous tissues were those in which most proteid matter would be found, choice was made of *Manihot glaziovii* Muell. Arg. (*Euphorbiaceæ*)* and the common lettuce, *Lactuca sativa*, L. (*Compositæ*). A considerable number of the young plants of the former of these was kindly raised by Mr. Irwin Lynch, at the Botanic Garden, Cambridge, and on their attaining a height of about 10 feet they were cut down and examined. On wounding them a milky latex exuded, but it was impossible to get this to flow in sufficient quantity to work with, hence another method of extracting it proved necessary. The young plants were cut down, their stems taken and freed from leaves and branches, and the cortex scraped off by a blunt knife. The mass of tissue was then finely minced, pounded in a mortar, and put into a quantity of water just sufficient to cover the pulp. After standing for twenty-four hours the whole was strained in a press through a coarse cloth, yielding a filtrate, turbid, and full of small particles of *débris*, chlorophyll granules, &c. In quantity it was about twice the bulk of the water used; this solution therefore was diluted latex, containing also any soluble matter originally present in the parenchymatous tissue of the cortex. Filtration, repeated many times, freed it ultimately from all colouring matters and *débris* arising from the preliminary treatment. Any soluble proteid existing temporarily or permanently in the tissue was hence in this extract.

The proteids normally present in the sieve tubes of *Manihot* have not been determined, but it is fair to assume that they do not materially differ from those of *Cucurbita*. From these Zacharias† has found it possible to extract a proteid body which behaves like a globulin.

* [The commercial source of Ceara rubber.—W. T. T. D.]

† "Bot. Zeitg.," February, 1884, p. 67.

It is insoluble in distilled water or in sulphate of soda solution, but is soluble in weak acids or alkalis. Its precipitate in distilled water is changed by contact with alcohol into a white stringy mass. It gives the xanthoproteic reaction, and that with copper sulphate and potassic hydrate. Fischer* has observed also that the fluid contents of the sieve tubes in *Cucurbita* become coagulated on heating.

The first investigation of the extract prepared as above, was not easy on account of the difficulty of getting rid of the soluble phosphates, which were found to be present in considerable quantity. They were removed by warming with ammonia, but the last traces were very hard to throw down. The liquid finally, however, ceased to give a precipitate with ammonium molybdate. Besides the phosphates the salts present were sulphates and chlorides, but both were much smaller in amount than the phosphates.

Having freed the extract from phosphates, it was found to coagulate on boiling, and the coagulum gave the xanthoproteic reaction. On heating it more slowly an opalescence was found to appear at 74—76° C., which was replaced by a precipitate at about 80° C. After filtering this precipitate off, no further opalescence took place up to boiling point. Dialysis for some time caused a precipitate, though not a very bulky one. Saturation of the neutralised liquid with $MgSO_4$ gave a precipitate, and a stream of CO_2 through a weak solution did the same. These reactions, taken together, indicated the presence of a globulin, of pretty much the same character as that found in *Cucurbita* by Zacharias and Fischer. They were not, however, quite conclusive, as several of the methods used would have thrown down, if it were present, the body described as occurring in latices examined before. This body was therefore looked for and found. After getting rid of the globulin by heating and filtering, the liquid gave the same reactions as those described before as belonging to that body. The dialysis especially was well marked, alcohol giving a proteid precipitate readily with the liquid outside the dialyser. The globulin was not so readily isolated, but it proved possible to get it by dialysis. It was not present in such large quantity as the other, and was more readily precipitated completely from its solution by saturation with solid $MgSO_4$, for the fluid, when both were present, gave a xanthoproteic reaction after it had ceased to give a precipitate on boiling. It was also precipitated on very large dilution.

Hence in the extract of *Manihot* are two proteids, one being globulin in nature and agreeing in its reactions with that of Zacharius and of Fischer; being satisfactorily separated from the other without injury only by dialysis; both giving precipitates on saturation with solid $MgSO_4$. A similar body to this globulin has been described by

* "Berichte d. deutsch. bot. Gesell.," vol. ii, No. 7, 1885.

Martin* as being present in Papaw juice. He speaks of it as being precipitated on boiling, the coagulating point being 70—74° C.; precipitated on dialysis; by CO_2 from dilute solution; and by saturation of its neutral solution with $MgSO_4$. The two appear to be identical.

An extract of *Lactuca sativa* was prepared in a similar way to that described in the case of *Manihot*. In this there was no globulin, but instead a proteid resembling Vines's† hemialbumose. It was precipitated on the addition of nitric acid, and the precipitate was largely soluble in excess. Addition of potassic ferrocyanide to this solution gave a precipitate. On filtering off the nitric acid precipitate it was found to be soluble in water and dilute alkalis, and the solution was not coagulated on boiling. The precipitate gave the xanthoproteic reaction. It differed from Vines's body in its solutions not giving the biuret reaction, but agreed with it in not dialysing. After removal of this albumose the extract contained in solution a quantity of the dialysable proteid described as occurring in previous cases.

Before leaving the investigation it seemed well to examine a plant which should belong to an order not specially laticiferous. The common cabbage (*Brassica oleracea*, L.), being succulent, was selected. Its examination was not particularly fruitful, bringing to light only the fact that the dialysable proteid was present there as well as in the other plants. It was not in this case examined very closely. No other proteid was found.

My researches, so far, agree with those of Martin in not showing the presence of true peptone in plants.

List of Proteids Found.

1. Dialysable proteid, resembling peptone.

This occurred in all plants examined. Its reactions may be summarised here:—

a. Soluble in water.
b. Not coagulated on boiling.
c. Precipitated slowly by alcohol, but not coagulated by the reagent.
d. Diffuses readily through membrane.
e. Is not precipitated by nitric acid, nor by acetic acid and by potassic ferrocyanide.
f. Is precipitated on saturation of its neutral or acid solution with solid $MgSO_4$.
g. Is precipitated slowly by a stream of CO_2 through its dilute solution.
h. Is converted into true peptone by the action of pepsin.
i. Does not give the biuret reaction.

* *Loc. cit.* † *Loc. cit.*

The body most nearly resembling this which has hitherto been described is that which is stated by Martin* to be produced by the action of papaïn on the proteids present in papaïn juice. It differs from the one now described in that it gives the biuret reaction, and is precipitated by acetic acid and potassic ferrocyanide. He says nothing as to its power of dialysis.

2. Hemialbumose (*Lactuca*)—

   a. Soluble in distilled water.
   b. Not coagulated on boiling.
   c. Precipitated by nitric acid and by acetic acid and potassic ferrocyanide.

This resembles very closely Vines's hemialbumose, and the body which Martin* has called α-phytalbumose. It differs in not giving the biuret reaction.

3. Albumose (*Mimusops*)—

   a. Soluble in distilled water.
   b. Not coagulated by boiling in neutral solution.
   c. Precipitated slowly by nitric acid at a temperature approaching 70° C.
   d. Not precipitated by acetic acid and potassic ferrocyanide.

4. Albumin (*Brosimum*)—

   a. Soluble in distilled water.
   b. Coagulated at 68° C.
   c. Not precipitated by acetic acid and potassic ferrocyanide.

5. Globulin (*Manihot*)—

   a. Precipitated by dialysis of its solution.
   b. Coagulated on heating to 74—76° C.
   c. Precipitated on saturation of neutral or acid solution with solid $MgSO_4$.
   d. Precipitated on large dilution.
   e. Precipitated by a stream of CO_2 through dilute solution.

Both the albumin and the globulin seem to be the same bodies as described by Martin as occurring in Papaw juice. The probable identity of the former with Boussingault's vegetable fibrin has already been alluded to.

* *Loc. cit.*